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# Pilot and Expanded Field Testing of the Erosion Control Management Plan (ECMP) for Army Training Lands: Lessons Learned

by
Eunice G. Vachta
Julian Hutchinson

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This report contains a summary of lessons learned during pilot and expanded distribution and field testing of ECMP. It presents difficulties encountered, successes realized, and the logical progression of events that has defined ECMP's applicability. This information can provide installation personnel with insights for decisionmaking involved in implementing ECMP for local needs.

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## FOREWORD

This research was conducted for the U.S. Army Engineering and Housing Support Center, under Project No. 4A162720A896, "Base Facility Environmental Quality," Task Number NN, Work Unit TD0, "Physical/Structural Erosion Control for Training Land Rehabilitation." The technical monitor was Mr. Donald Bandel, CEHSC-FC.

This work was conducted by the Environmental Division (EN) of the U.S. Army Construction Engineering Research Laboratory (USACERL). Julian Hutchinson is Chief of Natural Resources at Fort McCoy, WI. Dr. R. K. Jain is Chief, USACERL-EN. The technical editor was Gloria J. Wienke, USACERL Information Management Office.

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## 1 INTRODUCTION

### Background

Loss of Army training land to severe soil erosion at many Army installations clearly indicates that training lands are limited resources requiring careful management. In addition, effective erosion control management programs are needed to sustain quality training lands in support of the Army training mission. Years of training have damaged the protective vegetative cover on Army training lands and have, in some cases, caused progressively accelerated erosion resulting in losses of training areas and training realism, and reductions in water quality and wildlife habitat. Because the Army is focusing on environmental issues, installation land managers have growing environmental responsibilities and greater land rehabilitation and maintenance problems than ever before.

To manage training land more effectively under budgetary constraints and to comply with legislation mandating erosion and sediment control, the Army is adopting a comprehensive approach called the Integrated Training Area Management (ITAM) program.* To assist in this immense task, the U.S. Army Construction Engineering Research Laboratory (USACERL) has proposed the Erosion Control Management Plan (ECMP) as the erosion control component of ITAM. ECMP is a logical and standard process to help installation land managers plan, select, and implement erosion controls.

### Objective

This report contains a summary of lessons learned during pilot and expanded distribution and field testing of ECMP. It provides researchers, installation planners, and land managers with information about research activities associated with the development of ECMP. It also presents difficulties encountered, successes realized, the evolution of research that resulted in development of ECMP, and the logical progression of events that has further defined its applicability. This information can help installation personnel understand why particular approaches and methods were selected for ECMP application and can provide insights for decisionmaking involved in implementing ECMP for local needs.

### Approach

District conservationists from the U.S. Department of Agriculture and Soil Conservation Service (SCS) and natural resource and land managers from the Department of Defense (DOD) initially critiqued ECMP. Fort McCoy, WI conducted a field-test of ECMP in Fiscal Year 1989 (FY89) to validate the plan's theoretical aspects and test its practicality for implementation. The plan was further validated and refined based on feedback and additional review.

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* ITAM is being developed and field tested by the U.S. Army Construction Engineering Research Laboratory. Formal documentation will be published upon completion.

During FY90, ECMP was introduced to several Army installation land managers for implementation on a self-help basis. It was evaluated for application at U.S. Army Materiel Command (AMC) installations, used in total watershed management and planning, and tested as a tool for use in developing installation land restoration and maintenance planning documents.

**Mode of Technology Transfer**

This work will support the erosion control component of the Army's ITAM program. It is recommended that the information be distributed to the field through an Army Technical Manual and technical workshops.

## 2 LESSONS LEARNED FROM PILOT TESTING

### Overview

The pilot test evaluated concepts and procedures to identify erosion problems, assess needs, and select technology under field conditions. The evaluation included the concept validity, procedural practicability, and overall effectiveness of ECMP use in erosion control management on Army training lands.

Fort McCoy was selected as the pilot test site for the following reasons:

1. It affords typical Army training land conditions with varied terrain and erosion problems,
2. It conducts a wide range of tracked and wheeled vehicle training,
3. It displays a well coordinated effort between trainers and engineers, and
4. It has personnel with land management experience that is common throughout the Army.

In addition, mutual benefits could be realized by Fort McCoy and the research effort because the ECMP evaluation was to occur in the fall of 1988, which was the same time Fort McCoy was implementing their Training Area Recovery Plan (TARP). TARP is a joint effort of the Directorate of Plans, Training, Mobilization, and Security (DPTMSEC) and the Directorate of Engineering (DE). This 7-year plan schedules training areas for "rest" according to the DPTMSEC training schedule. The DE performs corrective work during the rest periods.

Under TARP, 2 to 4 training areas are withdrawn annually and are rested for 2 years. During the first year, all training is prohibited. Areas are cleaned of debris, barbed wire, and obstacles by DPTMSEC and the terrain is restored by DE. During the second year, training is permitted only for soldiers on foot. No vehicles are allowed. At the end of the second year, the rested areas become available for formal training.

The ECMP pilot test was totally compatible with TARP soil erosion control efforts on 4350 acres.

### Pilot Test Approach

Concepts and procedures to identify erosion problems were tested at Fort McCoy under conditions that could be expected to occur at many other Army installations. A hands-on, field-oriented approach was executed under conditions that included personnel turnover, rigid time constraints imposed by seasonal factors, procurement requirements, and a training area rotation schedule.

The pilot test was conducted in four phases: (1) initial implementation and evaluation, (2) modification and reimplementation, (3) erosion control design and construction, and (4) overall evaluation.

Phase 1. Early October 1988. During the first phase, managerial procedures were reviewed and site assessment procedures were discussed, tried in the field, and evaluated.

Phase 2. Late October 1988 to April 1989. A major segment of this phase was the reformulation and fielding of site assessment and inventory methods during November and December 1988. Final review and trials occurred in April 1989.

Phase 3. November 1988 to June 1989. This phase began with erosion control design for two Pilot Erosion Control Test Sites (PECTS) in November 1988 and ended with completion of erosion control projects during June 1989.

Phase 4. December 1989. Overall evaluation of the revised pilot test plan was completed in this phase. Continued monitoring by USACERL of two pilot erosion control test sites (PECTS-1 and PECTS-2) and numerous projects implemented by Fort McCoy during FY89 through the use of the ECMP in conjunction with Fort McCoy's TARP will continue through June 1991.

## Site Evaluation Procedures

The first version of ECMP consisted of six problem identification steps and five needs assessment steps, requiring a total of eleven evaluation sheets. During initial field testing of more than 90 individual sites, it immediately became evident that procedures had to be streamlined and evaluation forms condensed. Evaluation sheets should be brief yet allow the evaluator to accurately indicate site conditions and state needs in order to achieve resourcing objectives in the most timely and efficient manner possible. Onsite data recording needed to be minimized and procedures simplified in order to be manageable under difficult weather conditions, on rough terrain, and in circumstances requiring use of measuring devices and sample gathering equipment.

The field test emphasized the need to save time by (1) identifying and accomplishing information retrieval tasks that can be done in the office before making field investigations, (2) identifying and taking into the field all information, materials, and equipment required for fieldwork, (3) following a well-organized, concise checklist in the field and documenting the evaluation with brief entries to minimize return trips to the site, and (4) using a standard method to identify assessed sites in the field so they can be located again.

It became apparent through field testing that an excessive amount of time was being spent conducting detailed evaluation of sites that would require only a minimal level of recovery effort. This occurred because all evaluation checklist questions were applied to all kinds of sites. As a result, site assessment was separated into preliminary and detailed phases. The preliminary site evaluation includes determination of the treatment approach, site prioritization, and an itemization of factors used to generate cost estimates for sites requiring only minimal treatment. DPTMSEC determines what areas or types of damage should be repaired; NRMD determines how. Trainers must be involved in all aspects.

## Emphasis on Resource Requirement Projections

The pilot test underlined the value of a well-planned strategy when many sites must be assessed to project resource requirements. It emphasized the need for general management decisions concerning (1) execution of a well-defined and well-organized strategy for accomplishing resourcing objectives, (2) the most effective personnel utilization, and (3) milestone scheduling in accordance with the installation Annual Work Plan (AWP) budgetary cycle. Major goals of Army land management are to improve and maintain the land for training, and to conserve the environment. However, financial support of an

installation's land management program is crucial to the plan's existence and execution. The pilot test showed that the real costs and complexities involved in administering an effective land restoration and maintenance plan may be unknown until thorough problem identification, needs assessment, and land restoration efforts are undertaken.

Installation land management erosion control programs must be supported by cooperative attitudes and financial commitments at all levels (Department of the Army [DA], Major Command [MACOM], and installation). While very positive, cooperative attitudes pertaining to land management and natural resource conservation are shared by all organizations at Fort McCoy, the pilot test underscored the importance of timing milestones to accomplish financial resource projections used as input for the AWP and the Command Operating Budget (COB). The test also demonstrated the value of an efficient method of collecting quantitative field data for compiling land restoration estimates used for MACOM-level funding requests.

*Managerial Milestones for Annual Work Plan (AWP)*

Financial resource requirements for erosion control projects that will be included in the an installation's AWP normally must be projected during the second quarter of the fiscal year before the work will be done. As a result, it is necessary to designate quarterly managerial milestones that mark the progress and completion of all tasks associated with these resource projections. Figure 1 is a bar graph generated by Fort McCoy at the close of the first quarter of FY89. It itemizes and shows progress with tasks associated with TARP implementation during FY89.

It was necessary for Fort McCoy personnel to perform site assessments for both FY89 and FY90 (a total of 6600 acres) between October and December 1988 for several reasons: (1) site assessment could not begin until the first quarter of FY89 due to training schedules and personnel constraints, (2) FY89 resource estimates were needed as early as possible to determine the best ways in which very limited FY89 funds should be spent, (3) climate conditions curtailing site assessment from approximately December through February, and (4) resource requirements for the FY90 AWP are due by the end of the second quarter of each fiscal year. In addition to site assessment tasks, land restoration and recovery efforts had to be accomplished by the end of November and resumed in May as weather conditions and training schedules allowed.

Besides these milestones, other short-term administrative deadlines had to be established in order to complete tasks associated with seasonally sensitive land restoration. It became necessary to initiate personnel actions to obtain seasonal manpower and procurement procedures to obtain seed, soil amendments, materials, contracted services, and equipment rental in a timeframe that was in accordance with both seasonal and fiscal year requirements.

Projects that present potential training opportunities for troop units must be submitted to the Troop Projects Office (TPO) early in the fiscal year to allow selection and scheduling of projects. This is particularly the case at installations such as Fort McCoy where Army and Naval Reserve and National Guard units seek projects for completion during annual training.

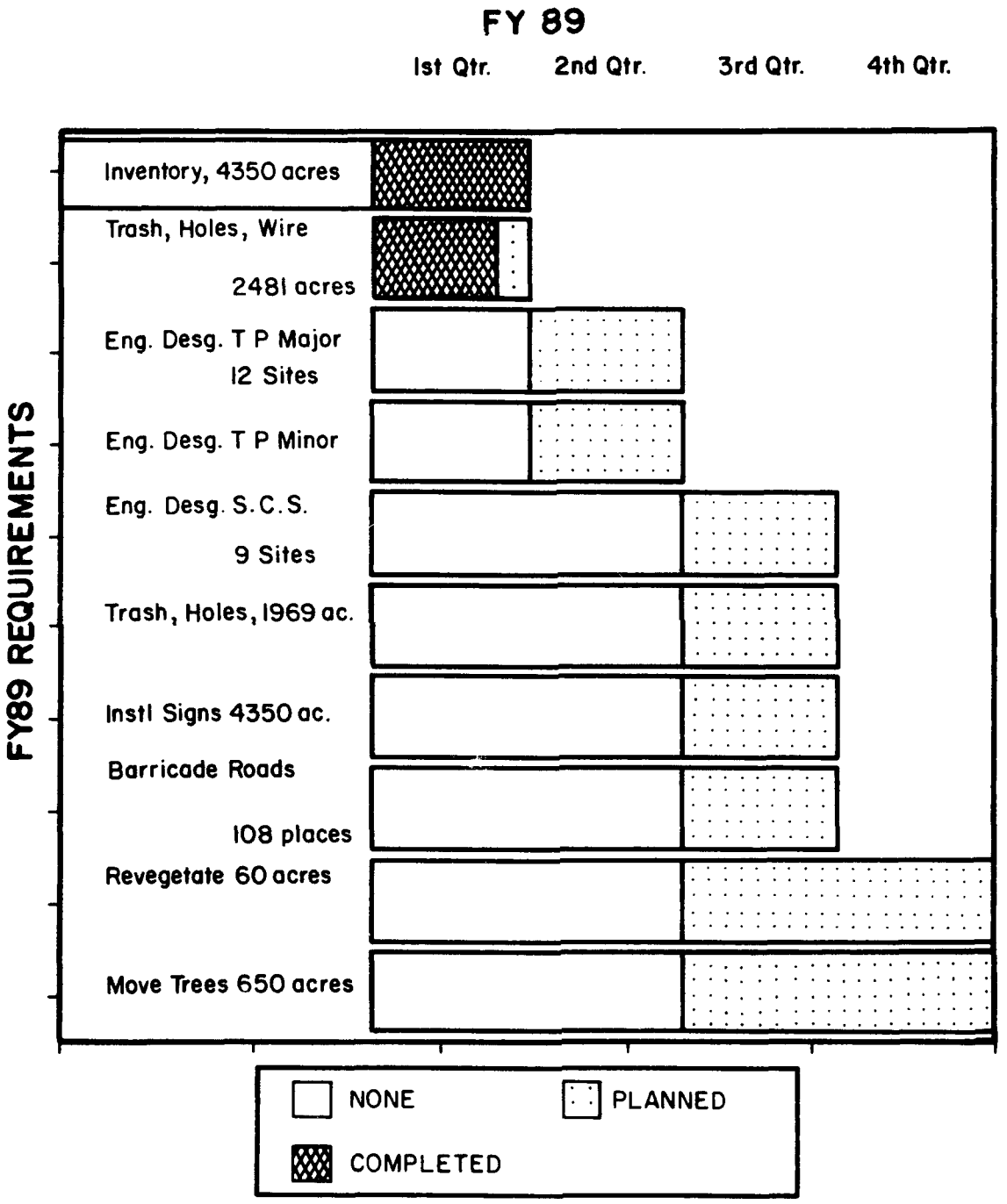


Figure 1. TARP tasks.

*Land Treatment Approach Criteria*

Emphasis on the financial and resourcing aspects of erosion control project management stimulated development of a resource-oriented site classification scheme used in preliminary site assessment. Criteria for assessing sites according to treatment approach were identified and step-by-step procedures were outlined to categorize sites according to the level of effort required for restoration. The erosion control treatment approach focuses on selecting the most appropriate available manpower resources for site conditions.

Development of treatment categories is affected by installation-specific circumstances and should be tailored by the land manager to accurately reflect them. The natural capability of the land and vegetation to recover due to climate and soil conditions is an important factor in developing treatment categories. Other factors that should be reflected in treatment categories include: available sources of technical assistance, modes of accomplishing work, and special circumstances affecting manpower and equipment resources. Table 1 shows criteria used by Fort McCoy to classify sites according to erosion control treatment approach.

*Eroded and Damaged Site Inventory Development*

The need to identify resource requirements for more than 90 sites demanded formulation of a well-organized, accurate, and quick method of tabulating data and computing cost estimates. By organizing collected data from sites having similar work requirements and cost factors into an inventory format, the land manager was able to systematically quantify resource needs for an entire group of sites. Table 2 is an example of this kind of calculation method used by Fort McCoy.

The site assessment and inventory strategy also had to identify eroded and damaged sites that should receive prompt attention or relatively high priority for rehabilitation. As a result, criteria for site prioritization was defined. Major considerations include the effects of soil loss and sediment yield on surface water quality, fish and wildlife habitat, nearby wetlands, and cultural resources on and off the installation. Any negative effects on training operations resulting from site degradation and the potential of the erosion problem to progressively degrade natural and cultural resources should also be considered.

An inventory of eroded sites provided a summary of land conditions for each training area. After sites are treated, inventory records can be retained in a separate file where they become a valuable data bank for future cost-estimating by providing information about the treatment approach, techniques, and resources expended for restoration.

*Erosion Control Technology Selection and Design*

The pilot test illustrated how criteria for selecting erosion controls, their design, and materials used for their construction reflect land management and training objectives. In accordance with TARP objectives to restore the land and vegetation, it was the intent of Fort McCoy's land management and DPTMSEC personnel to restore the land to a natural state. It was also decided that erosion control materials and techniques should provide low-cost, durable erosion control for at least the number of years until the training area would next be scheduled for restoration. This decision was made to keep maintenance

## Table 1

## Criteria for Erosion Site Classification According to Erosion Control Approach

| EROSION CONDITION | TOPOGRAPHY | VEGETATION/ GROUND COVER | EQUIPMENT TYPE | TECHNICAL SPECS. | TREATMENT APPROACH | CLASS |
|---|---|---|---|---|---|---|
| NO SIGNIFICANT DEGRADATION; NO APPARENT SOIL LOSS OR OFF-SITE THREAT OF EROSIVE RUNOFF OR SEDIMENT | ANY | CONDITIONS ARE HISTORICALLY SELF-HEALING: CAN RECOVER DURING REST PERIOD OF ROTATIONAL PLAN OR ONE GROWING SEASON | NONE | NONE | NO TREATMENT | 0 |
| WATER EROSION (SHEET,SPLASH, RILL) | SLOPES GENERALLY LESS THAN 5% | CONDITIONS HISTORICALLY CANNOT SELF HEAL IN ONE GROWING SEASON OR REST PERIOD OF ROTATIONAL PLAN | SMALL MAINTENANCE, CULTIVATION ie, DISC,HARROW,SEEDER, SMALL TRACTOR | FERTILITY & SEEDING SPECIFICATIONS | ROUTINE PLANTING AND SEEDING METHODS | A |
| a) WATER EROSION (SHEET,SPLASH, RILL,GULLEY) OR b) WIND EROSION | a) SLOPES GENERALLY BETWEEN 5 AND 12% FOR WATER EROSION OR b) ANY TOPOGRAPHY FOR WIND EROSION | ANY CONDITION REQUIRING TREATMENT | SMALL MAINTENANCE, SOME HEAVY CONSTRUCTION EQUIP. | SOIL CONSERVATION SERVICE (SCS) RECOMMENDATIONS AND CONSERVATION PRACTICES | INFORMAL DESIGN USING LESS COMPLEX AGRICULTURAL CONSERVATION PRACTICES | B |
| WATER EROSION WITH COMPLEX RUNOFF CONDITIONS OR SEVERE WIND EROSION PROBLEMS | SLOPES GENERALLY GREATER THAN 12% BUT NOT RESTRICTED | ANY CONDITION REQUIRING TREATMENT | HEAVY CONSTRUCTION, SOME SMALL MAINTENANCE EQUIPMENT FOR FINISHING TASKS | SOIL CONSERVATION SERVICE OR OTHER ENGINEERING SERVICES | FORMAL AGRIC,ENGR, OR OTHER ENGINEERING DESIGN;BIOTECHNICAL,GEOTECHNICAL & INNOVATIVE TECHNOLOGIES | C |
| ALL TYPES | ANY WELL DEFINED SMALL AREAS OR DEFINED SUB-AREAS OF LARGE SITES | ANY CONDITION REQUIRING TREATMENT | TROOP UNIT TYPE | ROUTINE ENGINEERING TASKS: LIMITED AND WELL DEFINED IN SCOPE: RELATED TO ARTEPS AND METL MAY BE JOB--PHASE SUB--COMPONENTS OF CLASSES B AND C | TROOP CONSTRUCTION | D |

## Table 2

## Summary of TARP Work Needs

**FY89**

| TA | 1* | 2 | 3 | 4 | Miles of Trails | 5a | 5b | 5c | 5d |
|---|---|---|---|---|---|---|---|---|---|
| 108 | 5 | 3 | 4 | 20 | 9.0 | 3 | 18 | 49 | -- |
| 109 | 2 | 1 | 1 | 17 | 3.5 | -- | 27 | 29 | -- |
| 209 | 5 | 2 | 4 | 29 | 8.8 | 4 | 14 | 30 | 1 |
| Totals | 12 | 6 | 9 | 66 | 19.3 | 7 | 59 | 108 | 1 |
| Est. Cost | | $15,050 | | $20,000 | | $2,100 | $9,750 | $2400 | $200 |

Total Unfinanced - $50,000 to fix a total of 268 sites.

**FY90**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 106 | -- | 4 | 7 | 19 | 2.52 | 2 | 6 | 10 | -- |
| 107 | 7 | 4 | 9 | 20 | 3.19 | 5 | 13 | 6 | -- |
| 202 | 6 | 4 | 3 | 6 | 0.0 | 4 | 8 | 11 | -- |
| 203 | (In MPTR area - no inventory taken) | | | | | | | | |
| Totals | 13 | 12 | 19 | 45 | 5.71 | 11 | 27 | 27 | -- |
| Est. Cost | | $31,500 | | $10,000 | | $3,300 | $4,500 | $600 | $0 |

Total Requirements - $50,000 to fix a total of 154 sites.

*Description of columns by number of sites:

1 - Troop Project Engineer design needed - major.
2 - Troop Project Engineer design needed - minor.
3 - SCS Engineer design needed - relates to agriculture.
4 - No engineer designs needed - inhouse (Grounds - NRMD) can do.
5 - Trail closure obstacles needed: 5a - needs berm, 5b - needs trees, 5c - needs logs, brush, etc., 5d - combination of a, b, and c.

requirements low for training areas not included in the current year's TARP restoration schedule. These considerations are reflected in the erosion controls selected and implemented at Fort McCoy.

During the pilot test, typical kinds of erosion sites were identified at Fort McCoy. Sites having characteristics that commonly recur due to similar geomorphology, geology, soils, erosion conditions, and land use could be treated with similar methods requiring only minor modification. As a result, a few readily constructible controls with easily modified standard designs were applied at many sites. In addition to being effective as erosion controls that were suitable for site conditions, the technologies selected for repeated application at Fort McCoy met criteria for training and environmental compatibility, low cost, constructibility, and material biodegradability.

The test demonstrated that the most cost-effective construction materials are most likely to be locally abundant either as recycled materials, mineral resources, or as byproducts from timber or agriculture operations. In fact, it was clearly demonstrated that in circumstances where stringent budgetary constraints exist, project feasibility is reduced as costs for formal design and construction increase. Although more complex and costly land restoration techniques would have been suitable at some sites, simpler, less costly, and perhaps less durable but appropriate controls were selected due to budgetary and manpower constraints.

Although pilot erosion control test site one (PECTS-1), was economically and durably constructed using recycled bridge timbers, railroad ties, and broken concrete pavement, these materials were not selected for application at similar sites. Rather, log timbers and soil berms were used to prevent traffic and provide soil stabilization in critical areas (Figure 2) largely because of aesthetic considerations in addition to meeting criteria discussed in this section. The log timbers were cut onsite from an abundant supply of scrub-oak that was unsuitable for timber sales. This reduced fuel costs and time associated with hauling materials to remote sites. Although the bridge timbers would not deteriorate as quickly as the log timbers, it was determined that the life expectancy of the log timbers would provide adequate time for soil stabilization. Their degradation over time would then result in organic materials and a natural appearing landform.

The pilot test also brought out the fact that sources differ on technical specifications such as application rates for seed and soil amendments. It is necessary to compare actual site conditions and future training land uses with the conditions for which the various recommendations were made. This evaluation should determine which of the recommendations, if any, are appropriate for use. For sites at Fort McCoy, soil amendment and seeding rates for critical areas as recommended by USDA-SCS and the University of Wisconsin Extension Service reflected conditions most accurately and produced good results during the first year after treatment.

Fort McCoy's DPTMSEC personnel were consulted regarding the compatibility of controls for anticipated training operations. Range safety and operations personnel identified special structural limitations such as cribwall height and length that might negatively direct or impede training activities. They determined that reinforcement rods in recycled concrete pavement would not be allowed due to troop safety hazards. Also, they evaluated placement of soil stabilization structures along slopes with regard to their effects on training operations such as access to observation and firing points.

Materials were closely evaluated for their potential to become undesirable debris or present a hazard to wildlife. Plastic netting on rolled straw mulch mats was monitored closely for evidence of chewing or snagging by deer and other animals before its complete degradation by sunlight. Plastic sand confinement grids used for soil stabilization at PECTS-1 had to be totally covered by shale and broken

**Figure 2. Log timbers and soil berms.**

concrete slabs to prevent displacement and destruction. The use of metal staples to secure rolled materials was allowed after careful evaluation from troop safety and residual perspectives.

Field testing of ECMP procedures confirmed that managers need to consider the environmental impacts of erosion controls, including the potential impacts on sensitive areas; wetlands; threatened and endangered species habitat; and archeological, historical, or other sites having cultural significance. The test demonstrated that because locations adjacent to streams have a high potential for being archeological sites, careful inspection of the site and archeological records should be undertaken when planning erosion controls.

One of the most valuable lessons learned was that the consultation process has a positive effect on land management program support. Integration of training requirements with natural resource conservation efforts resulted in cooperation between installation organizations. This cooperation provided a basis for identifying common goals and promoted a greater understanding of the training mission and natural resource concerns. Active participation by DEH, DPTMSEC, and troop units in planning strategies and performing tasks generates or reinforces a proprietary interest in the land restoration program.

## Erosion Control Implementation

Most of the erosion controls were implemented at Fort McCoy by an in-house civilian workforce. Activities associated with the pilot test and TARP implementation confirmed that the logistics of applying an erosion control plan have a direct influence on costs and efficient program execution. Distance to the site increases fuel costs and the time required to haul materials, drive or haul equipment, and transport personnel to and from work sites.

Crew types were defined by the kinds of tasks and equipment needed to accomplish site restoration. The more complex treatment approaches requiring various kinds of equipment or expertise also required additional job phases that were performed by different labor resources. For example, sites defined by Table 1 as Class B, requiring small maintenance and some heavy construction equipment, and Class D sites that offered training opportunities for troop construction also called for a job phase in which planting and seeding had to be accomplished. Crews skilled in particular kinds of work performed only those tasks.

Sites restored by troop units were subsequently scheduled for a final, agronomic phase in which the ground surface was finished, soil amendments were added, and seed was applied by in-house, civilian grounds maintenance personnel. This required coordination with the TPO to ensure that seasonally sensitive tasks were performed in a timely manner.

In view of logistics problems associated with distances to remote areas on post, it was most efficient to concentrate work efforts requiring similar crew and equipment types in adjacent areas. Job phases were completed in quick succession for neighboring sites. Site prioritization played a major role in establishing starting points.

Because crews were encouraged to modify standard erosion control designs for application at similar sites at Fort McCoy, competition existed between work crews to use the most suitable and effective erosion control features that would result in well-stabilized and natural appearing sites. Occasionally crew signatures were even affixed to finished structures. This increased workteam pride and yielded treatments and structures reflecting high quality craftsmanship. Figures 3 through 6 illustrate the structural variations that resulted from the standard designs illustrated in Figures 7, 8, and 9. By using the same workers as the TARP crew, experience was used and knowledge was increased as problems were solved. The crew finally concluded that no site problem was too difficult for them to solve and repair.

## Summary

Lessons learned from the ECMP pilot test at Fort McCoy are summarized below.

1. The best methods for site assessment should help the user save time by (1) providing a concise but accurate means for gathering all information needed for resourcing objectives, (2) separating tasks according to a well-organized approach for quick accomplishment, and (3) prescribing appropriate levels of assessment effort for various kinds of sites.

2. Managerial milestones for erosion project resourcing should be timed to allow accomplishment in accordance with the Army and installation fiscal year cycle and with regard to seasonally sensitive operations.

3. The site assessment and inventory strategy must allow early identification of sites that should receive prompt attention or relatively high priority for restoration. DPTMSEC determines what to fix; DEH determines how. Again, trainers must be involved at all levels.

4. Criteria for selecting erosion controls, their design, and materials should reflect land management and training objectives.

5. Because typical kinds of erosion sites could be identified at Fort McCoy due to similar natural conditions such as geomorphology, geology, soils, vegetation and land use, a few types of erosion controls were able to be modified for application at many sites.

6. The most cost-effective and best overall construction materials are most likely to be locally abundant either as recycled materials, mineral resources, or as byproducts from agricultural or timber operations.

7. In reviewing technical specifications for seed and soil amendment application rates, the user should select the recommendation developed for conditions and land use that are most similar to the site and future training requirements. In many cases, those conditions will be USDA-SCS recommendations for critical area plantings.

8. Locations along streams have a high potential for being archeological sites. The site and archeological records should be inspected for such evidence before planning land disturbance activities associated with erosion control implementation.

9. Consultation and planning interactions between range operations, land management, and troop unit personnel can provide a basis for identifying common goals and promote positive actions to integrate training mission requirements with natural resource conservation efforts.

10. Logistics problems associated with distances to remote areas require careful job phasing, project scheduling, and field crew management to accomplish erosion control implementation in the most cost-effective manner.

11. Initial guidance, encouragement, and occasional follow-on assistance can generate a "can do" spirit and workteam pride. The resulting treatments and structures reflect high quality craftsmanship.

12. Use same crew members once they master the tasks.

13. Do not forget the primary reason for controlling erosion is to preserve the quality of training lands.

**Figure 3. Troop constructed project finished by ground maintenance crews.**

**Figure 4. Substitution of log timbers for railroad ties on a steep slope.**

**Figure 5. Log timber control on a gentle slope.**

**Figure 6. Slope stabilization at varying elevations.**

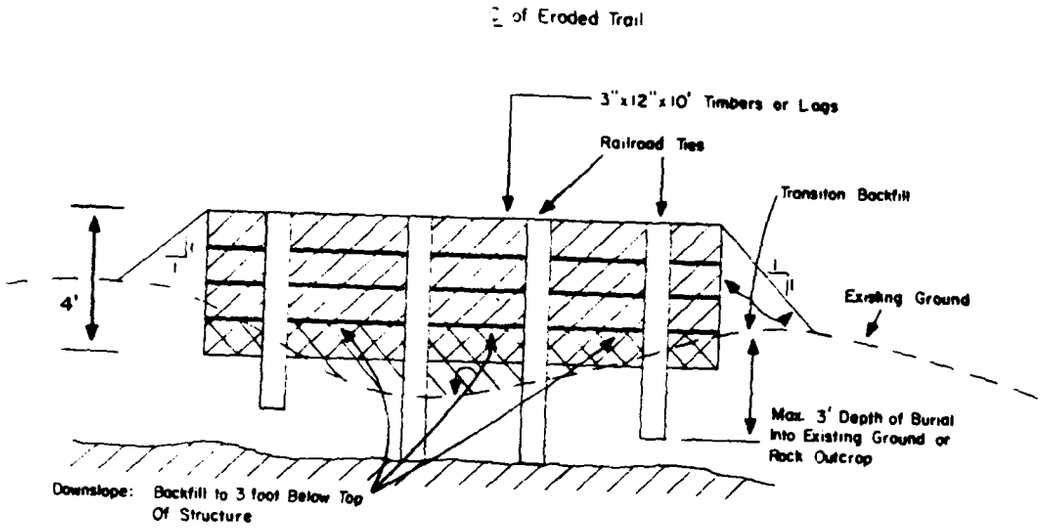


**Figure 7. Front view of standard design (PECTS-1).**

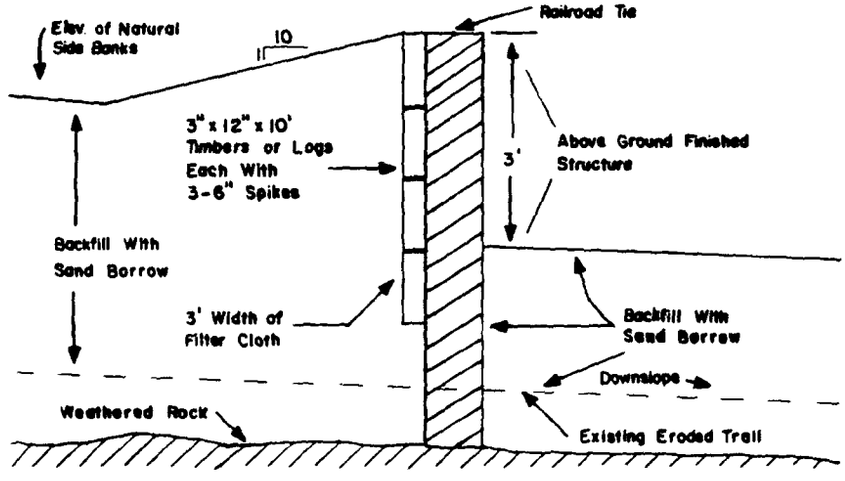


**Figure 8. Side view of standard design (PECTS-1).**

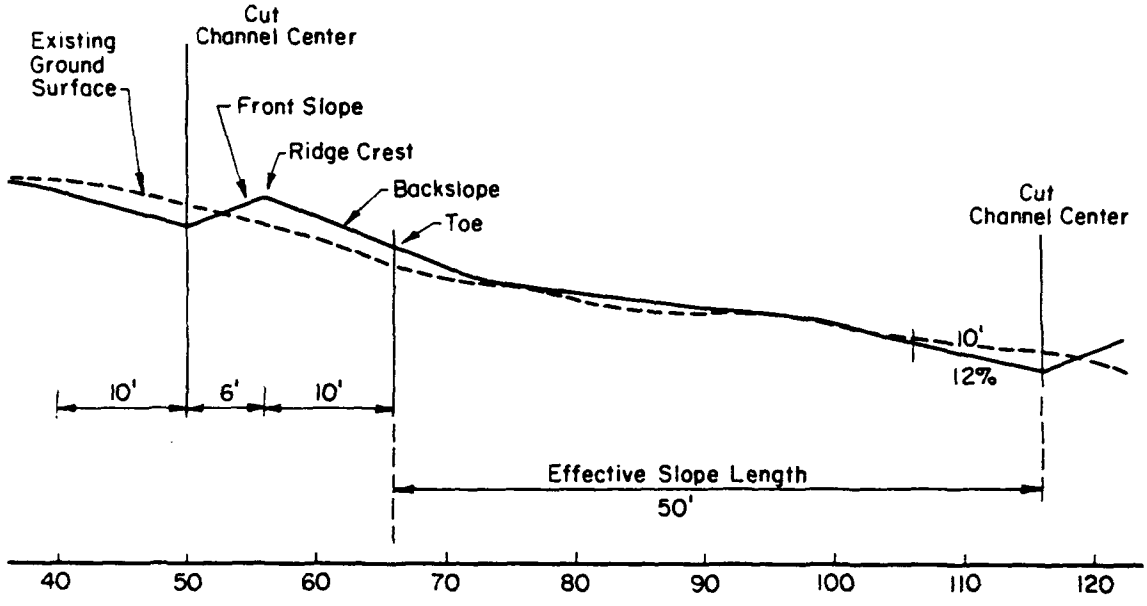


**Figure 9. Standard design of PECTS-2.**

# 3 LESSONS LEARNED FROM EXPANDED DISTRIBUTION AND FIELD TESTING

## Overview

In FY90, refined ECMP site assessment procedures were tested by USACERL to determine their usefulness under a variety of circumstances on Army lands. Application was extended to AMC installations where Army lands are used primarily for purposes other than training. Six AMC installations were visited and site assessments were made at four of them.

The assessment procedures and newly identified elements of ECMP's final version were also used by USACERL at several other installations as part of ongoing training area research projects. ECMP was tested in circumstances where training area rotation plans are not in effect and at two installations in conjunction with a watershed management and planning concept.

The final draft version of ECMP was distributed to natural resources and land management personnel at several Army installations for review and trial use on a self-help basis. Lessons learned from these expanded applications are presented here.

## Extending ECMP to AMC Installations

ECMP was evaluated for its applicability at AMC installations where little or no land is designated as training area. The evaluation took place because (1) the Army recognizes that erosion control is a vital part of land management on all Army lands, (2) ECMP has problem identification and needs assessment elements that with some modification might apply to typical conditions that prevail at AMC installations, and (3) uniform fiscal year cycle and resourcing requirements exist for all installations and allow for the same project origination and management procedures at AMC installations.

USACERL researchers visited Sierra Army Depot, CA; Lexington-Bluegrass Army Depot, KY; Anniston Army Depot, AL; Letterkenny Army Depot, PA; Red River Army Depot, TX; and Lone Star Army Ammunition Plant, TX, to examine the feasibility of transferring training land erosion control restoration and maintenance technologies for their needs. This examination included assessing needs to identify AMC special requirements that might require technology modification.

The visits revealed that many kinds of eroded sites occur at AMC installations on training lands or at other locations having similar natural conditions. Figure 10 is an example of such a site. The photograph shows the effect of wind erosion along an installation fenceline. The selection and success of erosion control can be constrained by security requirements that may differ according to location.

The ECMP problem identification process for eroded site assessment involves examining site conditions and those factors contributing to erosion processes, including natural conditions and human activities as they pertain to land use. The needs assessment and technology selection processes involve examining the appropriateness of erosion control. A control's appropriateness pertains to its function, its suitability for use under prevailing natural conditions, its impact on any environmentally sensitive conditions, and its compatibility with training mission requirements.

**Figure 10. Typical eroded site along a fenceline.**

Although human activities as they pertain to land use on Army training lands might vary considerably from other kinds of land use, the land use factor must be considered during evaluation at any location. Likewise, while the training mission compatibility requirement might appear to be a rather unique element in the needs assessment process because it results in unique constraints, its inclusion parallels consideration of compatibility requirements for other kinds of land uses such as cropping practices, recreational objectives, or in the case of AMC installations, demolition activities, storage functions, or safety requirements.

Research associated with extending ECMP to AMC sites indicates that land use for demolition activities and storage functions having highly specialized safety and security requirements are only different replies to the same set of questions used for site evaluation on Army training lands. This research indicates that the questions are valid for site assessment on training lands as well as at AMC installations. Terminology used for training land evaluation could be easily modified for other types of Army lands.

While demolition grounds present unique problems for erosion control and land restoration efforts, preliminary research indicates that some of the problems may be very similar to those of construction sites. Both kinds of sites support activities that result in constantly changing conditions. Controls selected for these areas will focus on containment and mitigation efforts for sediment and runoff control. Temporary controls implemented daily as standing operating procedures (SOP) for routine demolition operations could be applied in much the same manner as erosion and sediment controls for construction sites. These controls should be backed up by more permanent controls for sediment containment and runoff located off the immediate demolition site.

There is a high potential for undetonated ordnance to exist on demolition grounds. This poses a problem for erosion control selection because it places constraints on the ways in which erosion controls

can be implemented. The high risks associated with land disturbance activities in such situations may necessitate special contracting requirements or make the project unfeasible for accomplishment by commercial contract. This situation underscores the importance of including erosion control SOP as part of routine demolition operations on a daily basis.

Similar to any installation or location where there is a high potential for hazardous materials to exist, restoration efforts at some AMC sites may need to include added specialized techniques. At those locations, groundwater well monitoring and other environmental testing is first necessary to confirm existing conditions. Soil cleaning or chemical treatment techniques may need to be included in land restoration efforts at contaminated sites. Such treatments may be required before establishing stabilizing vegetation for eroded sites.

**Expanded Field Testing of ECMP Site Assessment Procedures**

The ECMP site assessment procedures were used by USACERL researchers during FY90 on training areas at installations where erosion control research projects are in progress. These installations included Fort Drum, NY; Fort Campbell, KY; Fort Polk, LA; and Fort Bragg, NC. The feasibility of using the ECMP project origination and management guidance within the framework of existing Facility Engineering work management systems was examined. Because many aspects of the land management programs for erosion project origination and accomplishment vary among these installations, the overall study resulted in strong, practical conclusions.

Field evaluations at these installations supported several observations that were made at Fort McCoy. Time saving through the use of concise field methods and separation of tasks according to where and when they should be performed provided the best results during all installation visits. During these visits, time was limited for site investigations and archival information would have been difficult to obtain if a well-organized system for collecting data had not been used.

Expanded field testing indicates that training requirements heavily influence criteria for selecting erosion controls and aspects of their design. Work at Fort Bragg and Fort Campbell repeatedly underscored the importance of safety requirements for training lands that support airborne operations such as air assault and personnel drop activities. Specific location, size, visibility of control profile from aloft, kinds of structures, vegetation height, elimination of bodies of standing water, material composition, and avoidance factors are some safety considerations encountered in this work. Successful erosion control designs must be suitable for labor resources available for both implementation and long-term maintenance. They must be sized and have features designed for conditions at the most feasible, cost-effective level of maintenance. Expectations for levels of maintenance should be realistic and reflect available manpower resources at the installation.

Selection criteria for controls planned at Fort Polk and Fort Campbell include potential benefits of installed controls to serve dual roles regarding training operations and natural resource objectives. Project implementation can also serve as training for troop units. Erosion control projects at Fort Bragg's Sicily Flight Landing Strip and at a stream crossing have been planned and implemented by troop engineering units as a result of the training value of project tasks.

Expanded field testing of ECMP also examined various methods of designing and constructing erosion projects. This work showed that determining the treatment approach is one of the first steps

associated with all projects and must be resolved early in the planning process. Table 3 summarizes the various modes used during these expanded test activities.

Work at Fort Bragg revealed the need to consider both the short-term and long-term environmental effects of erosion control implementation. Land disturbance associated with erosion control implementation can have adverse effects onsite and offsite. Temporary erosion control and sedimentation plans are needed for construction sites to avoid damage caused by runoff and sedimentation. Installations located in states requiring such plans by law may have an agreement with the state to enforce this requirement on post-construction activities.

The long-term effects of implementing erosion control must also be considered during the selection process. The long-term effects on wetlands is of particular importance. At Fort Bragg control measures had to be carefully evaluated to ensure that wetland hydrology is not being altered by runoff controls implemented at Sicily Field Landing Strip.

Work at Fort Bragg also supported ECMP criteria pertaining to surface water quality for eroded site prioritization. According to ECMP, one of the foremost considerations for site prioritization is the effect that a site's soil loss and sediment yield has on surface water quality. This includes sites located adjacent to water as well as those sites situated a distance from the water that contribute sediment. Because the State of North Carolina has tolerance standards for stream turbidity levels, a major factor for prioritizing sites at Fort Bragg will involve measuring turbidity. Stream turbidity levels in water samples will be read by Fort Bragg in Nephelometric Turbidity Units (NTU) used by the State. Readings in excess of compliance standards will mark watershed locations that require site assessment and erosion control treatments.

**Table 3**

**Modes for Accomplishing Project Design and Implementation**

| Design | Construction |
|---|---|
| Agricultural Conservation Structures | In-House Personnel, Contract, Troop Units |
| Engineer Troop Units, Reserve, National Guard, Active Duty | Troop Units, Reserve, National Guard, Active Duty |
| Corps of Engineers District | Contract, Troop Units, In-House Personnel |
| Commercial A&E Firm | Contract |

Site assessments at all the installations indicate that because of similar natural characteristics pertaining to topography, geology, soils and vegetation, and similar land use and training requirements, typical kinds of eroded sites and erosion problems that occur repeatedly at an installation can be identified. These findings support previous determinations made at Fort McCoy.

*Watershed Planning and Management Concept*

Training land rest and rehabilitation programs such as that used at Fort McCoy restore large parcels of land designated as training areas on a rotational basis. This concept has been used because range operations are scheduled on a training area (TA) basis. Training activities can be discontinued and entire TAs shut down with little or no confusion for all concerned because their boundaries are clearly defined and recognized by users.

Erosion control planning on a watershed basis has also been considered by Army researchers and by some installations. The watershed planning and management concept involves integration of individual site restoration efforts from the perspective of the whole watershed in which sites are located. This concept focuses on interactions between natural processes within the entire watershed. Watersheds are divided into smaller parts called subwatersheds, which are analyzed to determine their contributions of sediment to the entire watershed system. Just as watershed characteristics and land management factors are analyzed in total watershed planning, prospective erosion controls are evaluated for their impacts on other parts of the watershed. The Water Quality Act of 1987 calls for the development of state watershed treatment programs.

It appears that there may be several problems associated with the watershed approach. Because training areas are scheduled for use as entire units by range schedulers, some kind of alteration to the scheduling system might be needed if only parts of the TAs could be used. Moreover, it can be difficult to clearly define irregularly shaped watersheds in the field in order to exclude training activities from areas where restoration is taking place. In those cases, avoiding small sites during training operations within an otherwise open training area might not be possible, or it may cause confusion. Another objection to the watershed approach is that the configurations of some watersheds and the terrain in conjunction with installation boundaries might be disruptive to large-scale combined arms and cross-country training operations. Closure of a series of watershed sites could also disrupt activities in several training areas due to strategic locations with regard to supply or maneuver corridors. Another consideration is that in many cases installation boundaries cross watersheds, thus precluding their total management by the Army. In such cases, upstream watershed portions may be contributing to problems on Army lands.

According to the watershed planning and management concept, erosion controls are implemented simultaneously or successively at sites that compositely make up a total watershed plan. A major advantage of this approach is that it involves closing small project areas within various TAs rather than removing entire TAs from training. This reduces the total area taken out of training at any given time and permits the use of TAs that might have terrain especially suitable for particular types of training operations.

ECMP can be used as a compatible tool for field evaluation and erosion project origination in conjunction with the watershed planning and management concept. This approach emphasizes the preliminary site assessment procedures of ECMP, including consideration of a site's position within the watershed. ECMP informs the user that solutions to a site's problems often involve treatment of sites located upstream and upslope.

Fort Polk, LA, successfully implements erosion controls according to the watershed planning and management concept. Its land management program exercises its cooperative agreement with the USDA-SCS for erosion project planning, design, and implementation. Watershed plans based on field inspection are developed and include all projects situated within each watershed.

USACERL is studying Fort Polk's approach and is augmenting it with automated watershed analysis methods. Work is currently underway at Fort Polk's Peason Ridge where USACERL is developing a watershed plan for the headwaters of Comrade Creek. USACERL is working with SCS and Fort Polk in the design and implementation of sediment retention and other types of conservation structures. By combining field inspections with automated physical process modeling that uses satellite imagery and geographic information system (GIS) data, sites have been identified and the effects of planned controls predicted.

At Fort Bragg, NC, a watershed planning and treatment approach is being developed specifically to address acute problems associated with stream water quality compliance. Portable turbidity monitoring field equipment is being used on surface waters to identify areas contributing sediment in excess of compliance standards. This approach links surface water quality turbidity levels (measured in NTUs) directly to eroded sites draining into the water.

Work at Fort Campbell, KY, involved working with the Corps of Engineers, Nashville District to develop designs for training oriented erosion controls on a watershed basis. The headwaters of a stream in the Veghel Drop Zone has been monitored for over 2 years. Data on precipitation, training activities, conservation structure damage and sediment concentrations have been monitored during this time. The erosion controls designed by Nashville District reflect training mission requirements. Military units using Veghel Drop Zone provided input into the designs. They were asked to identify characteristics of prospective controls that would adversely affect training as well as ideal conditions that would enhance operations. Dual functionality of controls for erosion control and training purposes was also emphasized in the design process.

*Developing Installation Land Restoration and Maintenance Plans*

The value of a long-term installation land restoration and maintenance plan that projects annual financial requirements was confirmed by Fort McCoy's experience with TARP. Expanded field testing of ECMP in conjunction with other concurrent erosion control projects indicate that ECMP could also be used as an effective tool with the watershed planning and management concept for originating installation land restoration and maintenance planning documents. These documents clearly present project prioritization, financial requirements, relationships with other watersheds, and land management factors. They should also be useful for master planning and, as in Fort McCoy's experience with TARP, they are valuable for supporting annual funding requests for erosion control projects. The financial resource requirement data generated by such plans assists MACOM and DA level decisionmakers with funding decisions.

## Expanded ECMP Distribution on a Self-Help Basis

During FY90, ECMP was introduced to several Army installation land managers for use on a self-help basis. Comments from individuals indicated that ECMP was applicable to land management problems and operations at those installations. In most cases, however, day-to-day activities prevented extensive review. Although procedural guidance for site assessment and project origination was considered a valuable reference, the system for developing an inventory of eroded sites required planning time.

Because plans for implementing ECMP need to be coordinated with the fiscal year cycle, a specific start date was needed. Daily responsibilities and suspensed actions superseded startup activities involved with ECMP.

*Need for Startup Workshop*

Results of expanded ECMP distribution on a self-help basis indicate that successful Army-wide implementation will require that ECMP be introduced initially to users through an introductory workshop. The workshop would provide a forum for questions and discussion and would identify ECMP as an ITAM component. Interactive discussion sessions and lectures would help participants understand procedures for identifying project requirements, selecting controls, and programming and executing erosion control construction within the existing DEH administrative systems.

*Installation Technical Assistance Needs*

The pilot and expanded field testing over a 2-year period confirmed original expectations that different levels of technical assistance would be needed at various Army installations. It was found that individuals tasked with erosion control have work experience and educational backgrounds in natural resources-related fields such as forestry, fish and wildlife management, biology, range management, agronomy, soils, and master planning. Erosion control responsibilities are often considered an additional duty. Vast differences in years of experience within the Army system or in a career field also exist. For this reason, the inexperienced individual needs step-by-step guidance. This same guidance, however, can serve as a summarized checklist for personnel more experienced in erosion control and project programming.

The experienced individual will be able to answer many questions presented on the evaluation sheets automatically during site evaluation without a conscious, step-by-step effort. Notations on evaluation sheets will be very brief in those cases. Regardless of how obvious decisionmaking might appear for a given site at the time, keep in mind that adequate records for sites and treatments will provide valuable information for future decisionmaking and resource estimating. Success of controls used to correct specific conditions noted will benefit managers of continuing projects and new personnel tasked with erosion control responsibilities.

## Summary

Lessons learned from the ECMP expanded distribution and field testing are summarized below.

1. AMC security and safety requirements parallel training requirements and training land use factors. AMC requirements are different replies to the same set of site assessment questions. The site assessment process for Army training lands is valid for sites at AMC installations.

2. Many erosion control problems associated with demolition grounds are very similar to those of construction sites. Controls for those kinds of sites will focus on containment and mitigation for sediment and runoff control.

3. Temporary controls implemented daily as SOP for demolition operations could be applied to those areas by workers skilled in demolition operations.

4. Additional specialized techniques may be needed for land restoration efforts at contaminated sites before establishing vegetation.

5. Criteria for selecting erosion controls and their design characteristics are influenced by training requirements. Troop safety is a major element of training requirements.

6. Successful erosion control design must be suitable for labor resources available for both implementation and long-term maintenance. Levels of maintenance should be realistic and reflect available manpower resources at the installation.

7. Short-term and long-term environmental effects of erosion control implementation need to be considered. Temporary control plans are needed during project construction involving land disturbance activities. Consideration of long-term effects of controls on any nearby wetlands is mandatory.

8. Stream turbidity levels as measured by local authorities enforcing water quality standards can be used as a factor for prioritizing projects at sites located in a drainage area.

9. Typical kinds of eroded sites and erosion problems can be identified based on commonly occurring natural characteristics pertaining to topography, geology, soils and vegetation, and similar land use training requirements.

10. Due to scheduling procedures, terrain, and watershed configurations, there may be difficulties associated with a watershed planning and management approach that involve closing small, treated erosion control sites in TAs that are otherwise open for training operations.

11. A watershed planning and management approach can be used on Army training lands in a way that can reduce the total area taken out of training at any given time.

12. Potential erosion control benefits can be increased by design and selection criteria that allow dual functionality of the control for training operations and natural resource objectives.

13. ECMP could be used as a tool to develop installation land restoration and maintenance planning documents. Its use with a watershed planning and management concept can clearly present project prioritization and relationships with other watershed and land management factors.

14. A long-term installation land restoration and maintenance plan projecting annual financial requirements can be used to support funding requests.

15. An introductory workshop is needed to introduce ECMP to installation land managers. They will require some guidance when starting the plan.

16. Different levels of technical assistance with erosion control are needed at various Army installations.

# 4 CONCLUSIONS AND RECOMMENDATIONS

Although work is still in progress on the extended application of ECMP and the erosion controls implemented through its use are still being monitored, several aspects of the field performance and feasibility for Army-wide ECMP use are evident.

## ECMP Implementation

The best procedural methods for site assessment should promote good organization and provide a concise, accurate means of collecting all information needed for resourcing objectives using appropriate levels of effort for various kinds of sites. Timing of managerial milestones to accomplish resourcing objectives must be according to the fiscal year cycle and seasonal considerations. The site assessment and inventory strategy must allow for early identification of sites having high priority for treatment. Because cost-effectiveness of ECMP implementation is affected by the distance factor, careful job phasing and project management is required. ECMP can be used in conjunction with a watershed planning and management approach in a way that will reduce the total area taken out of training at any given time.

Preliminary research indicates that the ECMP site assessment and inventory process can be validly applied at AMC installations because AMC requirements parallel training requirements and training land use factors. Because many erosion control problems associated with demolition grounds are similar to those of construction sites, it is recommended that temporary controls implemented as daily SOP for demolition operations be applied. These controls should be backed up by more permanent offsite controls focusing on sediment containment and runoff control.

Because the user can apply ECMP in conjunction with various land management approaches and personnel possess various degrees of technical expertise, it is recommended that an introductory workshop be attended by prospective users. The workshop will provide guidance for starting ECMP implementation.

## Benefits of ECMP Implementation

When used in conjunction with a watershed planning and management concept, ECMP is used as a tool to develop installation land restoration and maintenance planning documents that clearly present project prioritization and relationships with other watershed and land management factors. These documents, which project annual financial requirements, can be used to support funding requests at the installation and MACOM levels.

Consultations and interactions between range operations, land management, and troop unit personnel during ECMP's control selection process are beneficial because they can provide a basis for identifying common goals and integrating training mission requirements with natural resource conservation efforts. Because an effective erosion control and land management program must be supported by cooperative attitudes and financial commitments at all DA, MACOM, and installation levels, it is recommended that ECMP procedures be used to gain both areas of support.

## Environmental Considerations

While the long-term environmental effects of erosion controls are usually focused upon, there is a need to consider the short-term effects of erosion control implementation where land disturbance activities occur. It is recommended that temporary erosion control and sedimentation plans accompany designs for all land disturbing erosion control construction projects.

## Design Criteria for Erosion Controls

It has been observed that the most cost-effective construction materials are likely to be locally abundant and that successful erosion control design must be suitable for the labor resources available for implementation and long-term maintenance. However, maintenance levels should be realistic, reflecting available manpower resources of the installation and land restoration objectives. It has also been found that potential erosion control benefits can be increased by design and selection criteria that allow dual functionality of control for training operations and natural resource objectives. It is recommended that all these criteria be considered when determining erosion control cost-effectiveness.

## Standard Designs for Erosion Controls

Typical kinds of eroded sites and erosion problems can be identified at an installation due to commonly occurring natural characteristics pertaining to topography, geology, soils, vegetation, and similar land use training requirements. Therefore, it is recommended that a few kinds of readily constructible controls having easily modified standard designs be developed for use at installations. It is recommended that future research be directed toward this objective.

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